

ELECTRONIC FUNDAMENTALS



Service Practices 11:

DIAL CORDS
AND TUNING SYSTEMS

Service Practices 12:

BATTERY AND THREE-WAY
PORTABLE RECEIVERS



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York,

N. Y.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 11

DIAL CORDS AND TUNING SYSTEMS

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RCA INSTITUTES, INC.

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HOME STUDY SCHOOL**

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Service Practices 11

INTRODUCTION

In this booklet, you will learn about the mechanical action that takes place when the station-selector or tuning knob of a radio receiver is turned or a button is pushed to select a station. In addition, the repairs and adjustments of these tuning systems will be discussed. However, before learning about the *mechanical* action that takes place, you will learn a few things about the *electrical* action that takes place in a radio receiver when a station is tuned in.

In later Theory Lessons, you will learn why it is that capacitors and inductors can be used to tune in a station on a radio or television receiver. At present, all you need to know is that the electrical size of the capacitor and the inductors used for tuning determine the station to which the receiver is tuned. Changing the electrical size of the capacitor or the inductor changes the station that the receiver is tuned to.

In most radio receivers, tuning is done by changing the electrical size or capacity of the tuning capacitor only. The inductor connected in parallel with the capacitor does not have its size changed. Therefore, as shown in Fig. 11-1, a variable capacitor is connected in parallel with a fixed inductor.

The variable capacitor used for tuning is really made up of two or more variable capacitors. These capacitors are linked together so that they can be varied at the same time by rotating a single shaft. Such capacitors are called ganged capacitors. Figure 11-2a shows a ganged capacitor in the minimum-capacity position and Fig. 11-2b shows one in the maximum-capacity position. The plates that move when the shaft is turned are called *rotor* plates, while the plates that remain stationary are called the *stator* plates.

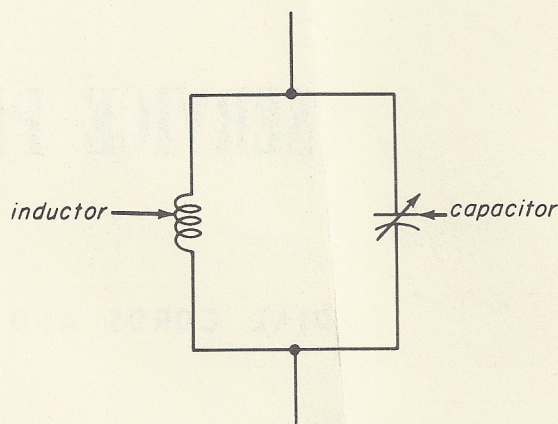
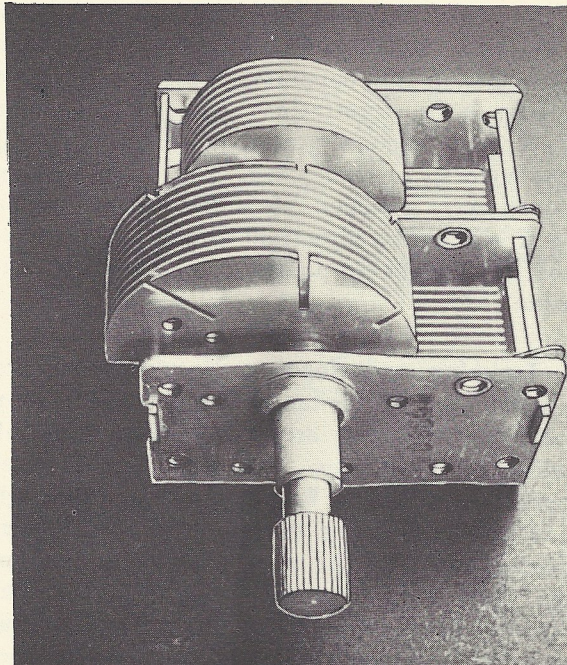


Fig. 11-1

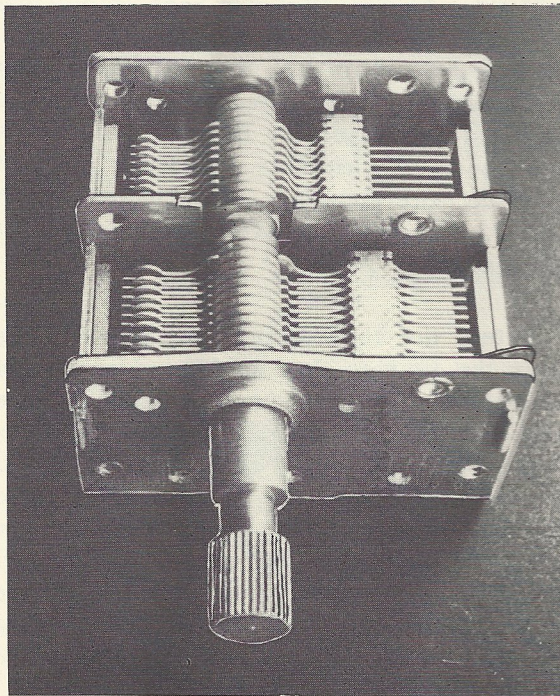
When the shaft is turned, all the rotor plates of all the sections of the ganged capacitor turn the same number of degrees in the same direction. When they turn into the stator plates, the capacitance of the ganged capacitor is increased; when they turn out of the stator plates, the capacitance is decreased.

As you remember from earlier lessons, each radio station broadcasts on an assigned frequency. By varying the capacitance of the tuning capacitor, you can tune a receiver to different frequencies, and so to different stations. When the plates of a tuning capacitor are almost fully meshed, the receiver is tuned in to the station with the lowest standard AM broadcast frequency (530 kc). When the plates are almost out of mesh, the receiver is tuned to the station with the highest frequency (1630 kc). When the capacitor is in different positions between these extreme points, different stations between the one with the lowest frequency and the one with the highest frequency are tuned in.

It is convenient to be able to tune to a station immediately without turning the shaft of the tuning capacitor until you happen to hit on the station you want. There-



(a)



(b)

Fig. 11-2

fore, most tuning dials or knobs are calibrated in kilocycles or in megacycles. How tuning is actually done is described in this booklet. Now we are ready to consider the different types of tuning systems used. These tuning systems differ in the mechanical arrangements for turning the shaft of the tuning capacitor and in the means used to indicate the position of the tuning shaft.

11-1. DIRECT TUNING

Operation. A very simple method of tuning is simply to put a knob made of wood or plastic on the end of the shaft of the tuning capacitor and simply turn the knob to tune the capacitor. Usually the shaft of the tuning capacitor comes through a hole in the front of the cabinet of the receiver, and the knob is attached on the outside of the cabinet, as shown in Fig. 11-3a. This method of tuning is called *direct drive* because the shaft is tuned directly by the turning of the knob.

In Fig. 11-3b, a large knob is used. On the knob, there are calibrations from 55 at one end to 160 at the other end. The number 55 stands for 550 kc and the number 160 stands for 1,600 kc. The end zero has been dropped off each calibration number. The numbers in between stand for the frequencies in between these extremes. Sometimes no zeros are dropped and the dial reads 550 on one end and 1,600 on the other end. Then the dial is calibrated directly in kilocycles.

As you can see in Fig. 11-3b, there is an arrow printed on the cabinet. When the knob is turned so that the arrow points to the 55, the capacitor is almost fully meshed and the receiver is tuned to the station that is broadcasting on 550 kc. When the knob is turned so that the arrow points to other numbers, the receiver is tuned to other stations.

Sometimes, instead of a large knob, a *drum dial*, as shown in Fig. 11-3c, is used. This drum dial, which works the same as the knob just described, is moved by being pushed with the thumb. Sometimes the drum dial protrudes through a slotted hole in the front of the cabinet of the receiver; sometimes it is mounted on the side or the top of the cabinet.

On some receivers, the knob on the shaft of the capacitor is smaller and has either a projection that serves as a pointer or a pointer painted on it. The numbers are embossed on the cabinet. This type of direct drive is shown in Fig. 11-3d. This time it is the arrow that moves, but the result is the same. When the arrow points to 550 kc, the capacitor is almost fully meshed, and the receiver is tuned to the station that broadcasts on 550 kc.

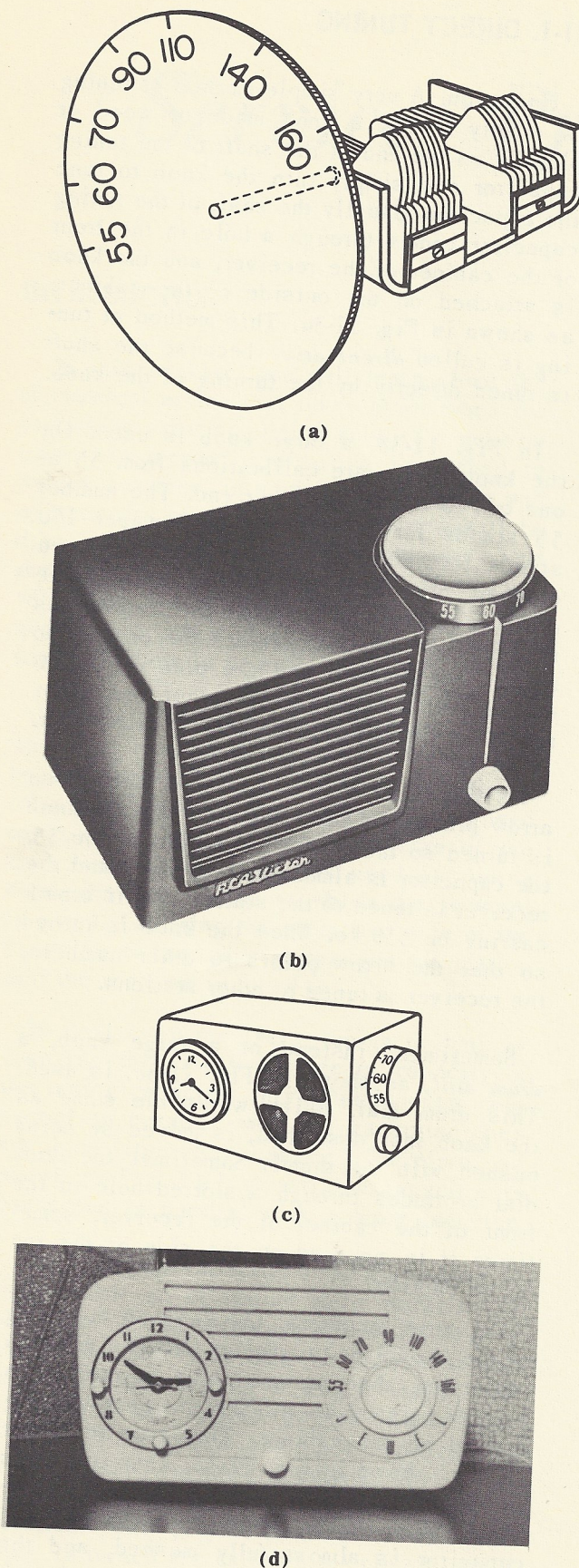


Fig. 11-3

In some cases, the lowest- and highest-frequency station numbers on the dial face may be in an opposite position to those shown in the illustrations. This is due to the difference in construction between the tuning capacitors. In one case, the fully-meshed position is reached when the dial is tuned in a clockwise direction; in the other case, the fully-meshed position is counterclockwise.

Troubles and Repairs. Very few defects are found in direct-tuning systems. The only possible troubles are tuning-dial or knob defects. Sometimes a plastic tuning dial becomes warped. Warping results in high and low dial spots that rub the front panel of the cabinet. The procedure is to replace the dial. It is best to purchase a new dial directly from the radio manufacturer. A dial that has a number corresponding to the correct model number of the radio set will always be correct. If a new knob or dial cannot be purchased, there are ways to repair a defective knob or dial. Try pulling the knob back slightly away from the front panel, or, if possible, loosen the radio-chassis screws and push the chassis forward slightly to provide more clearance. The chassis screws should be tightened after the clearance is obtained.

Often, the knob spring that normally creates the tension that holds the tuning dial or knob securely to the tuning shaft either loses its tension, breaks, or is entirely missing. A new spring may be made from a piece of metal and fitted into the spring recess of the tuning dial or knob hole. Sometimes the hole becomes enlarged, causing a loose fit that allows the knob to slip off the shaft of the tuning capacitor whenever the receiver is tuned. If the receiver is an outdated model and the tuning knob cannot be replaced, a narrow piece of friction tape can be wrapped around the shaft-end to take up the slack and enable the tuning knob to grip the shaft more securely.

When replacing a station-indicating dial or knob that has the station frequency marked directly on it, be sure that the low-frequency station markings on the new dial are on the same end of the dial as the markings on the dial being replaced.

11-2. FRICTION DIAL DRIVE

Operation. Figure 11-4a shows a method of turning the shaft of a ganged capacitor by means of friction drive. In this case, the tuning control does not *directly* turn the

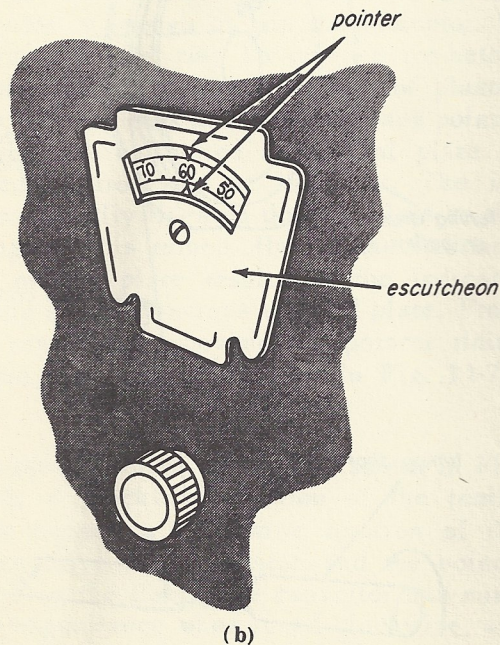
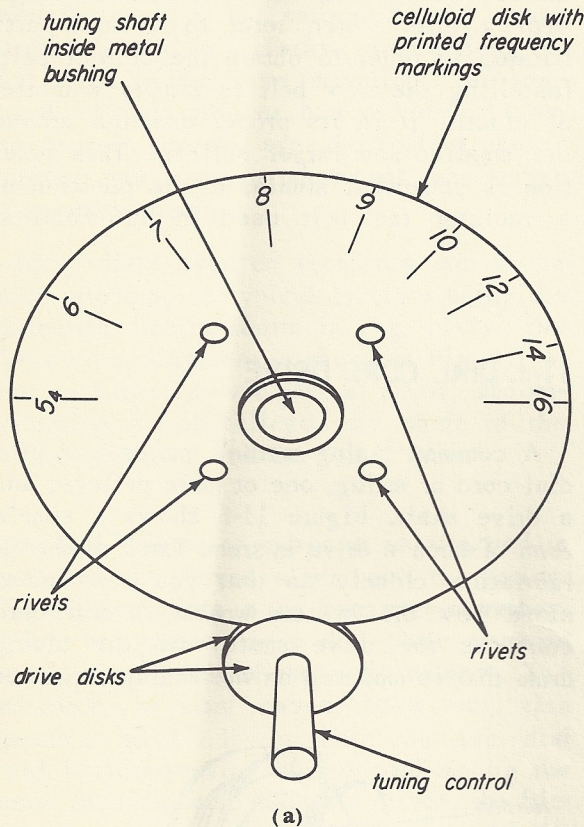


Fig. 11-4

capacitor shaft. Instead, the knob turns a split, circular spring-metal wheel that presses against and pinches the edge of a larger circular celluloid disk, which is connected to and turns the shaft of the capacitor. A metal bushing is riveted to the celluloid disk. This bushing is fastened to the shaft of the tuning capacitor with a set screw. The station-frequency markings are printed on the celluloid disk. The celluloid disk is placed behind the receiver's front panel. A hole sawed in the front panel of the receiver allows the number to appear. To conceal the edge of the hole for the sake of appearance, a bronze or plastic escutcheon is either screwed or nailed over the hole. At the opening of the escutcheon, there is a finger-like projection that serves as a pointer, as shown in Fig. 11-4b.

The friction dial drive has an advantage over direct drive. When you turn the knob of the tuning dial, the small knob rotates. Several turns of the small wheel are required in order to make the larger knob go around once. Therefore, it is less likely that a person will speed by the station he is trying to find when he is using a friction dial drive than when he is using a direct drive. Therefore, it is possible to tune in the receiver more accurately because the tuning capacitor can be very gradually meshed to the desired point.

Troubles and Repairs. A common defect found with this method of tuning is a worn celluloid disk. The edge of the disk becomes worn due to the pressure of the disk between the outer edges of the two smaller metal circular wheels. It is difficult to repair a celluloid disk. A worn dial should be replaced.

11-3. DIAL BELT DRIVE

Operation. A tuning method that was formerly very common but which is not used very often in late-model receivers is shown

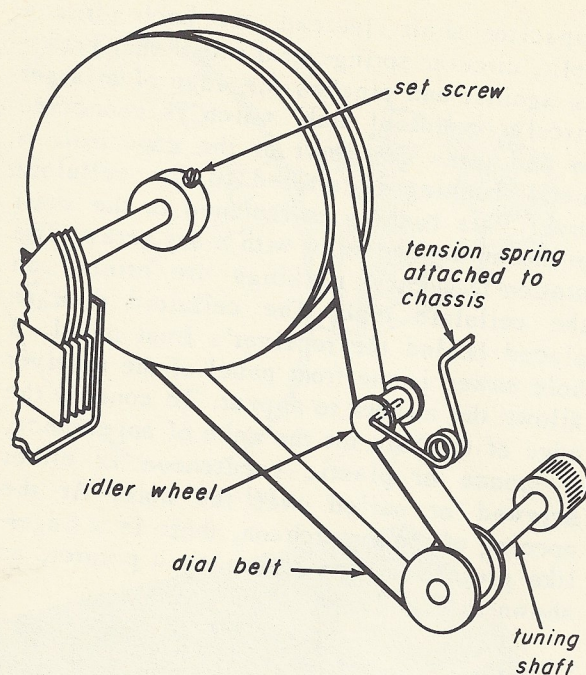


Fig. 11-5

in Fig. 11-5. The metal pulley on the tuning-knob shaft and the larger pulley on the ganged-capacitor shaft are connected by a dial belt. Several turns of the tuning-shaft pulley are required to make the capacitor-shaft pulley turn one time. The idler pulley shown in the figure is held against the dial belt by spring tension and keeps the belt taut.

The dial face appears through a hole sawed in the panel. A decorative escutcheon conceals the edges of the hole. The indicator is part of the escutcheon (shown in Fig. 11-4b).

Troubles and Repairs. The most common trouble is that the dial belt is not exerting proper pressure. The dial belt may become stretched, frayed, or broken. Frayed or worn belts should be replaced. Sometimes it is possible to take up the slack in the stretched belt by increasing the pressure of the spring of the idler pulley. If the belt is stretched so much that the slack cannot be taken up in this way, it should be replaced.

Fabric dial belts should be replaced with belts of the same length and width. To determine the length of a broken or frayed belt, cut it, lay it out straight, and measure its length with a ruler. To determine the length of the dial belt required to replace a stretch-

ed dial belt, wind a thin piece of thread — not heavy string — around the dial pulleys. Hold the thread in place with your finger and cut it off *exactly* at the point at which the free end of the thread meets the length of thread from the spool. Then remove the thread, lay it out, and measure its length with a ruler. Then refer to a radio-parts catalog in order to obtain the correct belt. Installing the new belt is simply a matter of placing it in its proper position around the smaller and larger pulleys. This position is somewhat similar to the position of a radiator fan belt used in automobiles.

11-4. DIAL CORD DRIVE

A common tuning method makes use of a dial cord or string, one or more pulleys, and a drive shaft. Figure 11-6 shows a simple form of such a drive system. Look at the illustration closely so that you can understand how the system works. A dial cord connects the drive shaft with the tuning-capacitor drum that is mounted on the tuning-capacitor

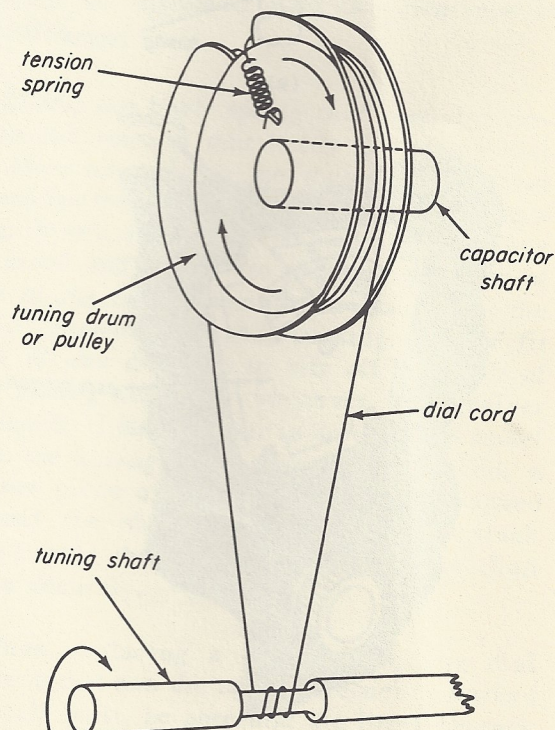


Fig. 11-6

shaft. The cord is wrapped three times around the drive shaft so that it will not slip off. One end of the cord is wrapped around the tuning drum, passes through a little hole in the tuning drum, and is fastened to the tension spring. The other end of the dial cord is wrapped $1\frac{1}{2}$ turns around the drum then fastened to the spring. As the tuning shaft is turned in a clockwise direction, the dial turns in the same direction. The front panel of the receiver has a hole. An escutcheon is screwed over the hole. A plastic cabinet may have an adornment that serves as an escutcheon.

Many dials used on receivers are of the slide-rule type. A typical receiver using the slide-rule dial is shown in Fig. 11-7a. The dial cord arrangement is shown in Fig. 11-7b. The cord travels over several small, smoothly-turning metal pulleys, the shaft of the tuning capacitor, and the pulley drum.

A dial pointer or indicator is attached to the cord and moves along with the string. The pointer points to the frequency markings, which are printed on a dial plate mounted on the front panel of the radio cabinet. The indicator, in most cases, is a long, thin metallic strip. It is held on the dial cord by interleaving of the cord among the metal tabs. In some dial-cord drives, the friction between the cord and the tabs of the indicator is enough to grip the indicator. In others, the tabs may be crimped for better gripping. In still others, a drop of plastic cement on the tabs holds the cord and pointer together. A calibrated metal dial plate is placed in front of the indicator. The indicator usually rides on the dial plate as the tuning knob is turned. Having the indicator ride on the plate results in the indicator moving smoothly across the dial plate. Front and rear views showing the pointer riding on the dial plate are shown in Fig. 11-7c.

In the dial-drive mechanism shown in Fig. 11-7b, a clockwise rotation of the tuning shaft causes a clockwise rotation of the pulley drive and capacitor, and the pointer moves to the right. The capacitor has minimum capacitance when tuned clockwise, and the dial pointer is at the high-frequency end of the band.

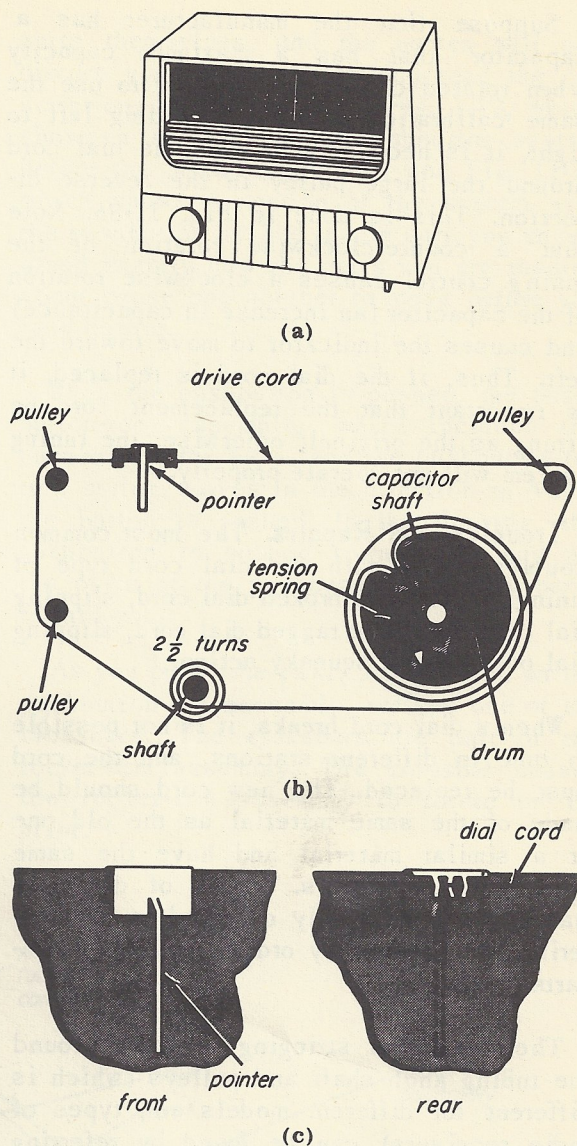


Fig. 11-7

Tuning systems using dial cords provide a smooth, easy method of tuning radio receivers. However, since radio receivers are made in many different sizes, shapes, and models, there are many different types of dial-cord tuning systems. Each system has its cord length, drum-pulley size, number of idler pulleys, type of indicator, size and type of spring (or springs), etc. Some systems use a thin cord; others use a medium- or thick-diameter cord. Most dial cords are made of either nylon or linen; a few are made of stranded or braided bronze-metal cable. Many slide-rule dials are calibrated so that the low-frequency (530 kc) end is at the left end of the slide-rule dial scale and the high-frequency (1630 kc) end is at the right end of the scale.

Suppose that the manufacturer has a capacitor that has a maximum capacity when rotated clockwise. In order to use the same calibration dial face, reading left to right, it is necessary to wind the dial cord around the large pulley in the reverse direction. This is done in Fig. 11-8b. Note that a counterclockwise rotation of the tuning control causes a clockwise rotation of the capacitor (an increase in capacitance) and causes the indicator to move toward the left. Thus, if the dial cord is replaced, it is important that the replacement cord be strung as the original; otherwise, the tuning system will not operate properly.

Troubles and Repairs. The most common troubles found with the dial cord type of tuning systems are broken dial cord, slipping dial cord, frayed or ragged dial cord, slipping dial pointer, and squeaky action.

When a dial cord breaks, it is not possible to tune in different stations, and the cord must be replaced. The new cord should be made of the same material as the old one or a similar material and have the same diameter or thickness. Spools of dial-cord material can be easily obtained in any material or thickness by ordering from a radio-parts catalog.

The method of stringing the cord around the tuning knob shaft and pulleys (which is different for different models and types of radio receivers) can be found by referring to either the radio manufacturer's service notes or special booklets describing how to restring dial cords. These service notes and booklets show clear and simple drawings with directions for dial-cord installations for past and present model receivers.

For example, suppose that the dial cord shown in Fig. 11-7b were broken. How would you proceed to install a new one? Here are the steps:

1. Remove the pieces of broken cord from the shaft and pulleys and separate the dial cord from the dial pointer.
2. Select a new dial cord from a spool that is made of a similar material and has the same thickness as the broken cord.

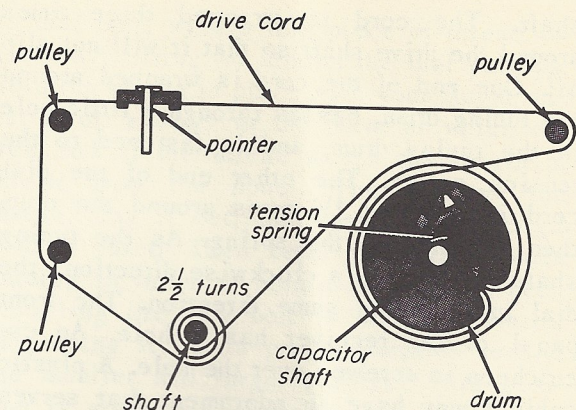


Fig. 11-8

3. Turn the large drum pulley until the ganged capacitor plates are fully-meshed, generally in a counterclockwise direction.

4. Tie one end of the new dial cord to the top anchor point of the large drum pulley and then loop the cord around the drum pulley $1\frac{3}{4}$ times in a clockwise direction, as shown in Fig. 11-7a.

5. Then wind the cord $2\frac{1}{2}$ times in a clockwise direction around the tuning knob shaft.

6. Continue, by allowing the cord to pass over the left-hand lower idler pulley, the upper left-hand idler pulley, the upper right-hand pulley, and part of the larger drum pulley.

7. Carefully tune in a radio station and then install the dial pointer in its proper position on the dial spring so that the pointer shows the true frequency reading of the station on the dial scale. Slightly tighten the metal tab on the pointer so that it grips the dial cord without slipping. Apply a drop of cement to the pointer tab.

Caution: Do not make the length of dial cord too short. This will cause the dial spring to be stretched too far. Do not allow the dial spring to be stretched too far.

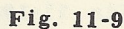
A slipping dial cord is usually due to either a cord that has stretched or a spring that has lost its tension. This can be cured by making the length of the original cord slightly shorter or replacing the spring with one that is slightly shortened and has more tension. Dial springs can be obtained in a large variety of sizes, and, together with

A frayed or ragged dial cord should be replaced with a new one, even though the dial action is working, because it is only a matter of time before the cord is sure to break.

Operation. The pushbutton system is a clever way to tune in a station without turning the tuning knob. All you have to do is press a button marked with the letters of the station you wish to get and the station is automatically tuned in for you.

parts themselves, and the names will not disturb you too much. As you read the description, look carefully at Fig. 11-9, which shows a section of the pushbutton system before the button is pushed, and Fig. 11-10 which shows a section of the system with the pushbutton pushed in. Be sure you understand exactly how the parts you are reading about cause one another to move before you read further.

As you push, the pawl, a projection on the pushbutton-rod assembly, strikes one of the crossbars. The crossbars are part of the rocker-arm assembly. The crossbar causes the rocker-arm assembly to rotate on its pivot.



In Fig. 11-9, the upper projection strikes the upper crossbar. The upper crossbar, and the rocker arm assembly of which it is a part, move in the direction of arrow A until the lower crossbar strikes the lower pawl projection, which stops its movement and the rotation of the rocker-arm assembly. The rocker-arm assembly and the rack gear attached to it move in the direction shown by arrow A, and the pinion gear turns in the direction shown by arrow B. (It is possible that the rocker-bar assembly previously may have been rotated in the direction of arrow A. We will discuss this situation later.)

If you have mastered the explanation of the principle of the pushbutton system, you will have no difficulty in understanding the function of the other parts of the pushbutton assembly shown in Fig. 11-9. The pushbutton-return spring, for example, does just what its name indicates. When you push the button, the spring is compressed, and when you release the pushbutton, the spring expands and pushes the button back to its original position. When the spring pushes the pushbutton out, the rocker-arm assembly does not move. The rocker-arm assembly is moved only when the button is pushed in.

You will notice that the end of the pushbutton assembly is against a dog. The dog, which has a curved side, is attached firmly to the slide plate. When the pushbutton is fully pushed in, as shown in Fig. 11-10, the pushbutton assembly slides along the curved edge of the dog and presses the dog in direction X. The slide plate, which is firmly attached to the dog, moves along with it.

The dog is attached to one arm of the slide plate. Attached to the other arm of the slide plate is the inside face of the clutch. When the slide plate moves in direction X, the inside face of the clutch moves in direction X and no longer makes contact with the outside face of the clutch. When the two faces of the clutch are separated, the clutch is said to be *disengaged*.

Notice that the manual-tuning control is geared to the inside face of the clutch. When the clutch is disengaged, if you turn the manual-tuning control the inside face of the clutch will turn, but it will have no effect on the outside face of the clutch or the tuning capacitor shaft. Also, when the clutch is disengaged, when a pushbutton is

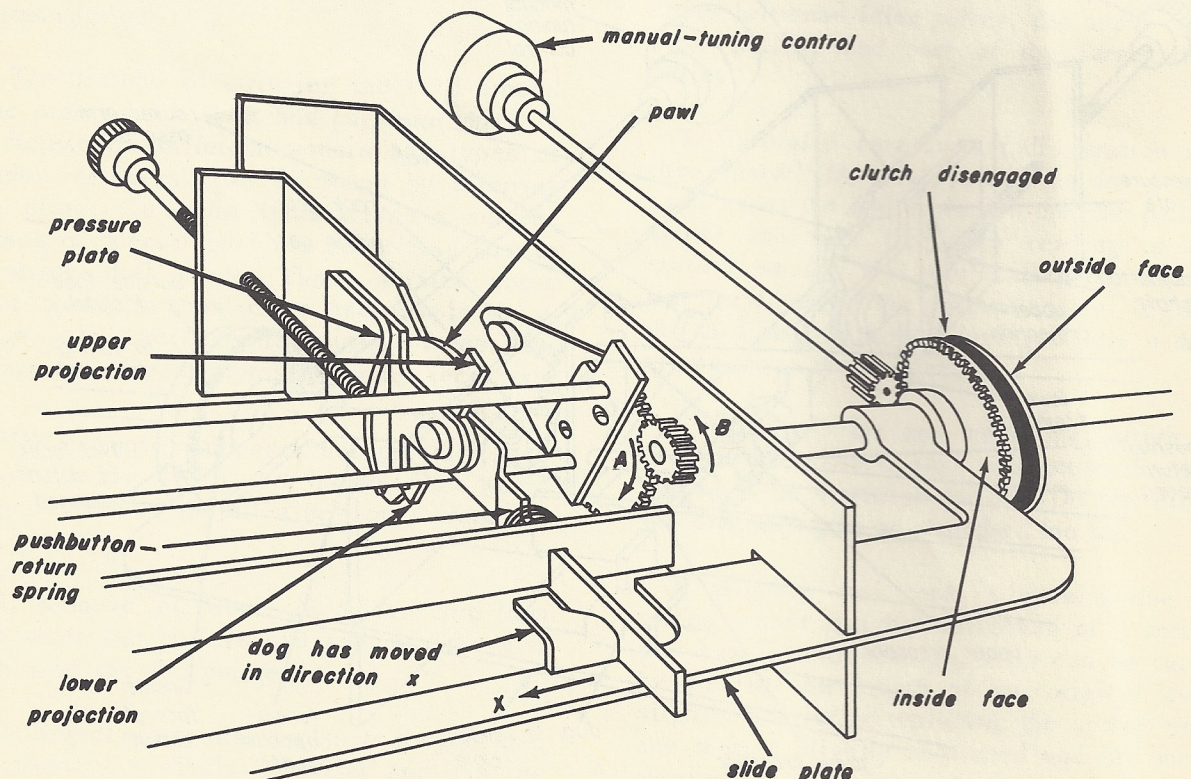


Fig. 11-10

pushed, the tuning-capacitor shaft, which passes through but is not attached to the inside face of the clutch, turns. Therefore, the manual tuning control is taken out of operation when a button is pushed because one of the results of pushing the button is to disengage the clutch.

Let us go back to the pawl. You have learned that the position of the pawl determines how far the rocker-arm assembly will move and how far the tuning capacitor will turn. The position of the pawl is adjusted when a radio receiver is installed.

In order to adjust the position of the pawl, the pawl must be loosened. The pawl is held in position by the shaft of the pushbutton assembly, which presses on the pressure plate, which squeezes the pawl against the backplate assembly. Once the pawl has been loosened by loosening the adjusting screws that hold it in place, the pawl can be moved into the desired position and the screws holding it in place can be tightened.

The purpose of changing the position of the pawl is to enable the pushbutton to tune in a particular station.

The amount that the shaft of the tuning capacitor turns depends upon the amount the rocker-arm assembly has moved, which, in turn, depends upon the position and the angle of the pawl. You can see, for instance, that if the pawl were close to the crossbar or at a different angle in the position of rest, the rocker-arm assembly would be pushed farther in the direction of arrow A.

Therefore, if you wished to have a pushbutton push the rocker assembly more or less than it is pushed by the pushbutton shown in Fig. 11-9, you would adjust the pawl so that the pawl projection was in a different position.

The other pushbuttons in the pushbutton system, of which the pushbutton shown in Figs. 11-9 and 11-10 is a part, have their pawl projections in different angles or positions.

So far, we have been discussing what happens when the top projection hits the

top crossbar. Now let us suppose that one of the other pushbuttons has been pushed so that the rocker-arm assembly has been pushed farther in direction A than the pushbutton shown in Fig. 11-9 could push it. If you wish to tune in the station that is tuned in by the pushbutton shown in the illustration, you must now get the rocker-arm assembly to move in the reverse of direction A. This is where the lower pawl projection comes in. When the rocker-arm assembly is so far in direction A that the upper pawl projection cannot hit the crossbar, the lower pawl projection hits the lower crossbar, and the rocker-arm assembly moves in a direction opposite to direction A. The upper pawl projection acts as a stop.

Adjustment. Suppose that you were installing or servicing a radio receiver that has mechanical pushbutton tuning of the type shown in Figs. 11-9 and 11-10. The owner of the set has moved from another city, and, at the time of installation, it is necessary to adjust the pushbuttons. To adjust the pushbuttons, do the following:

1. Turn on the receiver and allow it to warm up for 15 minutes. The volume control should be turned all the way up. In a home radio receiver with a variable-loop antenna, the variable-loop antenna should be adjusted to the maximum signal position. In an auto radio, the antenna should be fully extended.
2. Remove the four plastic pushbuttons by pulling them away from the flat metal pushrod shafts. The adjustment screws will then be accessible.
3. Place a screwdriver in one of the adjusting screw slots and loosen the screw by turning the screwdriver in a counterclockwise direction (never more than two turns). This loosens the plates that hold the pawl.
4. Carefully tune in one of the selected stations, using the tuning knob. While the station is being properly tuned in, keep the screwdriver in the adjusting screw slot and push against the screwdriver. This pushes the pushrods forward, and the crossbar causes the pawl to be in the proper position.
5. Tighten the adjusting screw.

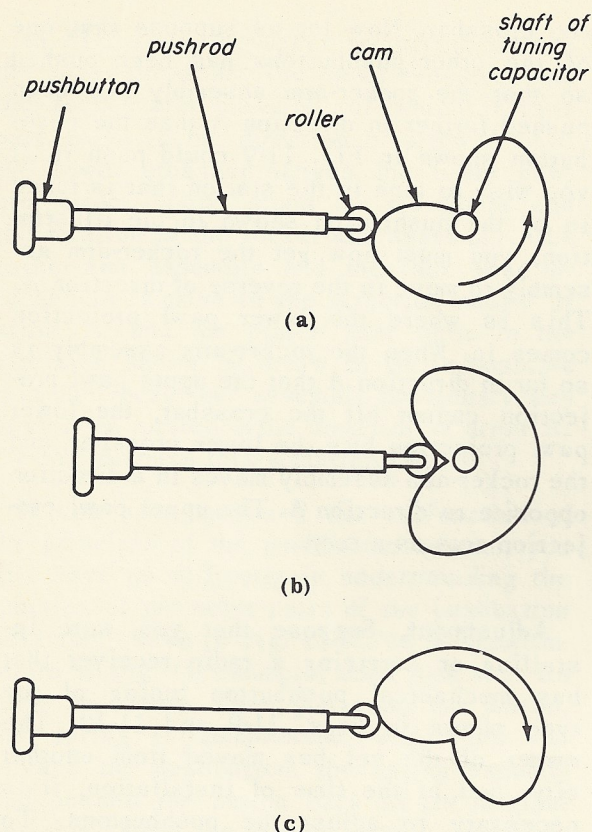


Fig. 11-11

6. Choose another station that is to become a pushbutton-tuned station. Tune it in with the tuning knob, at the same time pressing against the adjusting screw with the screwdriver, as described before.

7. When the station is properly tuned in, tighten the screw as before.

8. Follow the same steps for the other stations that are to become pushbutton stations.

9. Reinstall each plastic pushbutton by pushing it firmly onto the flat metal pushrod.

10. Label each push-button with the call letters of the station to which it is tuned.

11-6. CAM-OPERATED MECHANICAL PUSHBUTTON-TUNING SYSTEM

Operation. Another mechanical pushbutton-tuning system use four or five heart-shaped cams mounted on the shaft of the capacitor.

There is one cam for each station to be tuned in mechanically. A cross-sectional view of part of a cam-operated pushbutton tuning system is shown in Fig. 11-11.

When the pushbutton is pressed in, the pushrod is pushed. The roller on the end of the pushrod pushes on the heart-shaped cam and causes the cam to rotate counterclockwise. The cam is mounted on the shaft of the tuning capacitor. When the cam turns, the shaft turns in the same direction.

The cam stops turning when the roller rides into the cleft of the cam, as shown in Fig. 11-11b. Therefore the tuning shaft of the capacitor also stops turning. If the capacitor had been rotated to another position, as shown in Fig. 11-11c, pressing the pushbutton and rod would cause the same result. That is, the rotation would be clockwise and would stop when the pushrod reached the cleft.

Since the stopping position of the cam determines the frequency or station being tuned in, a pushbutton can be made to tune a different station by setting the cam in a different position. There may be as many four or five cams on a shaft, one for each station to be tuned in by pushbuttons. Figure 11-12 shows the perspective position of three such pushrods and cams.

There is usually manual tuning in conjunction with this type of pushbutton tuning.

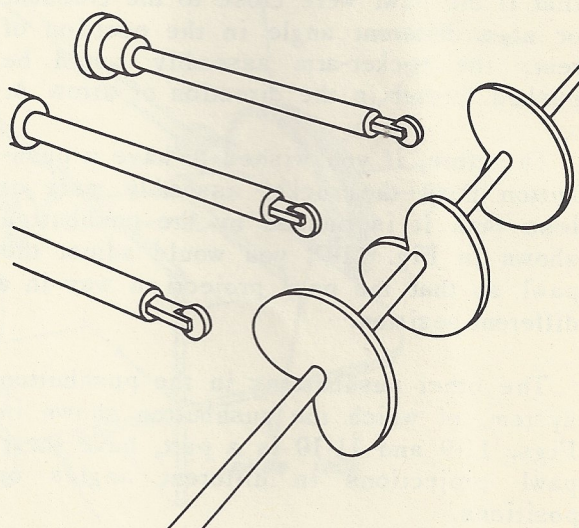


Fig. 11-12

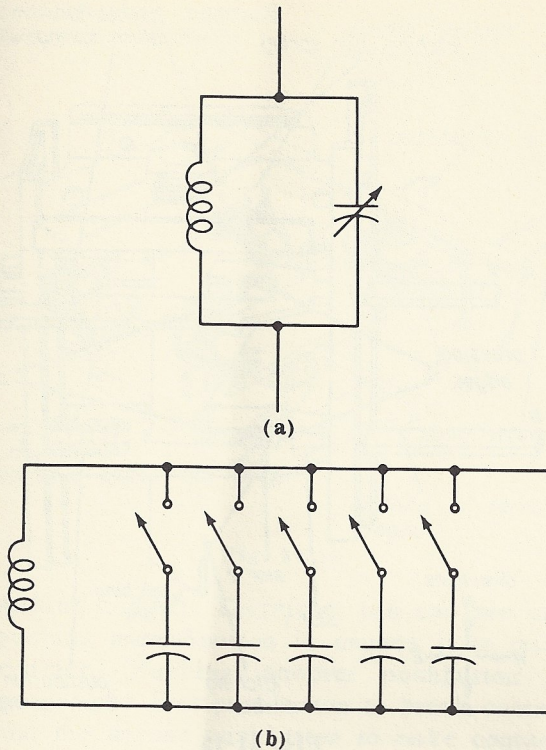


Fig. 11-13

A dial-cord system similar to those described earlier in this booklet is generally used.

Troubles. Generally speaking, the pushbutton assembly does not break down. If the tuning goes out of adjustment because of shift of the electrical tuning due to aging of components or mechanical slippage, the pushbutton adjustments should be reset.

In case of dial-cord trouble, the technique for replacing the dial cord is the same as discussed earlier in this booklet.

11-7. ELECTRICAL PUSHBUTTON SWITCH

Operation. You have already learned about the mechanical-pushbutton system that is used to turn the shaft of a tuning capacitor. The electrical-pushbutton system, although it looks somewhat like the mechanical system when you look at it from the outside of the receiver cabinet (you see pushbuttons in both cases), is actually a complex switch. This switch is used to switch different capacitors or indicators into the tuning circuits. Let us see how this can be done. In

Fig. 11-13a, you see the coil-capacitor combination that forms the tuning system you know about. When the variable capacitor is varied, its capacitance changes, and so does the frequency. The same effect could be obtained by using a large number of separate fixed capacitors as shown in Fig. 11-13b. Of course, many capacitors would be required to reproduce all the possible positions of a variable tuning capacitor. The drawing shows only five fixed capacitors. This number allows five favorite stations to be tuned in. By using the switching arrangement shown in the schematic diagram, any one of the five capacitors can be switched into the circuit.

The electrical pushbutton system is simply a switch that makes use of pushbuttons to do this switching. Figure 11-14 shows the schematic diagram of this switching system. Notice that there are two parts of this circuit. One part is used for tuning the r-f section of the receiver and the other section is used for tuning the oscillator section. You remember from your study of the variable capacitor that two ganged capacitors are used to tune the r-f and oscillator sections when manual tuning is used.

The switching system is of the double-pole single-throw type. Throwing one switch places two capacitors into two circuits. The capacitors that are used are trimmers, which will be discussed further in this booklet. For example, with one switch operation you

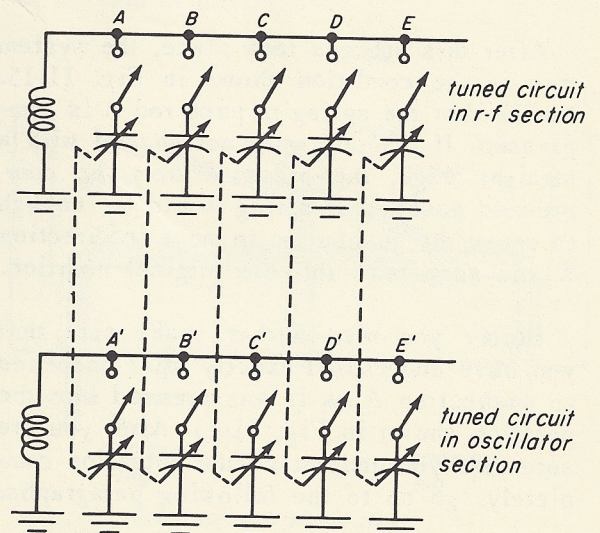


Fig. 11-14

place trimmers *A* and *A'* into the circuit of your receiver.

The capacitors shown are trimmers. When one switch of the pushbutton assembly is thrown, it releases any other switch that has been thrown. If you examine Fig. 11-15, the drawing of part of the pushbutton assembly, you will see how this is done. In the figure, pushbutton *A* is pushed in. Pushbutton *B* (the only other pushbutton shown) is not pushed in. Let's see what happens when a pushbutton is pushed in.

The first thing to notice is that the latching bar moves in directions N or S. Before pushbutton *A* was pushed in (direction E), pushbutton *A* was in the same position as pushbutton *B*. The stem of the latching bar and the dog of the locking bar were both in slot 2. When pushbutton *A* was pushed in, the pressing edge of slot 2 pushed against the curved side of the dog. The pressure on the dog was enough to push the latching bar in direction S, and the solid portion between slot 1 and slot 2 covered the dog. At this time, the latching-bar spring, which compresses when the latching bar is pressed down, was compressed. Naturally, when this spring is compressed, it exerts a force in direction N. So, as pushbutton *A* was pressed farther in and slot 1 came into position above the dog, the dog popped into slot 1 as the result of the pressure from the latching-bar spring.

After this process took place, the system was in the condition shown in Fig. 11-15. Notice that the spring of push rod *A* is compressed. If the dog were not shaped with a straight edge, the pressure from the compressed pushbutton spring would be enough to cause the pushbutton to move in direction W and snap back into its original position.

Before you read further, make sure that you have understood exactly what happened to pushbutton *A* as it was pressed into the position shown in Fig. 11-15. After you are sure that you understand the operation completely, go on to the following paragraphs.

Now let us see what happens when pushbutton *B* is pressed in. So far as pushbutton

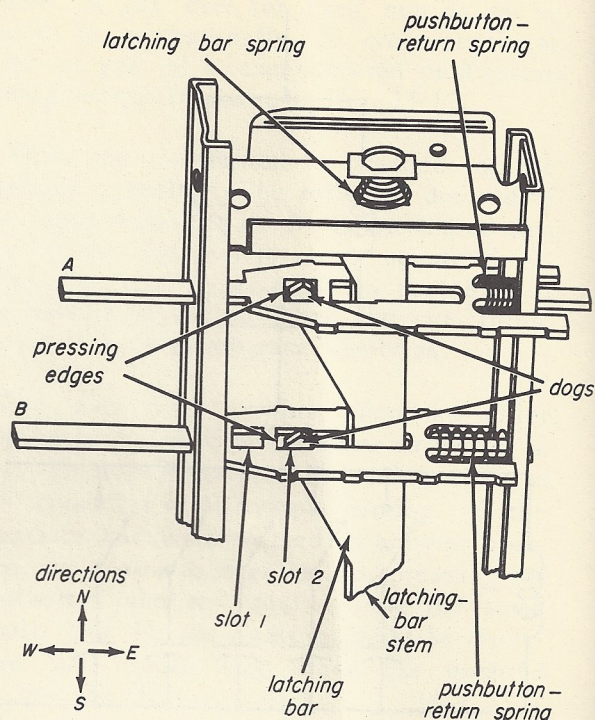


Fig. 11-15

B is concerned, the operation is the same as that of pushbutton *A*. But, as the pressing edge of slot 2 on pushrod *B* presses against the dog and causes the latching bar to move in direction S, the movement of the latching bar pulls the other dog out of slot 1 of pushrod *A*. The compression spring of pushrod *A* causes pushbutton assembly *A* to snap back to its original position now that the dog no longer interferes with this movement.

Let us return to what happens to pushbutton assembly *B* when it is pressed. Just as was the case with pushbutton *A* when it was pressed in, slot 1 of pushbutton *B* comes into place over the dog and pushbutton assembly *B* is held in position. If another pushbutton is pushed, pushbutton assembly *B* will snap back to its original position.

The whole purpose of the pushbutton switching arrangement is to make and break the contacts and, by so doing, to switch in different trimmers. Figure 11-16 shows how this is done. The switch shown in Fig. 11-15 has been turned over. However, pushbutton *A* is still pushed in, just as it was in Fig. 11-15. Notice that the switch blades of pushbutton *A* are now making contact with the contact points. The switch blades of pushbutton *B*, which is not pushed in, are not

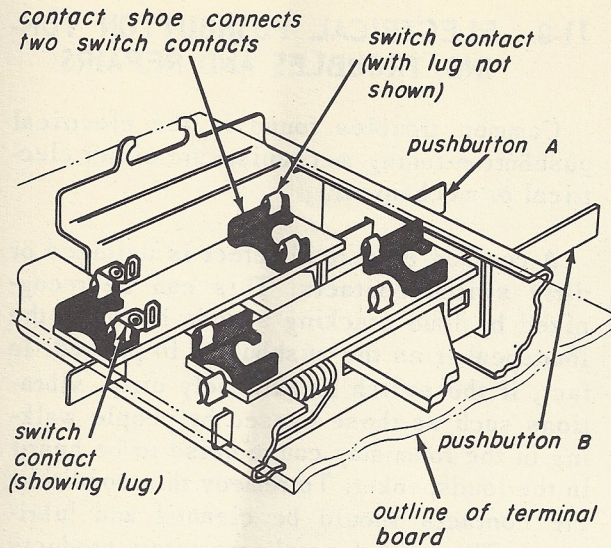


Fig. 11-16

making contact. Therefore, you can see that pushing a pushbutton in causes it to make contact. Pushing another pushbutton in causes the first pushbutton to break contact and the second pushbutton to make contact.

The switch contacts shown in Fig. 11-16 go through the terminal strip and are attached to lugs. These lugs, on the top side of the terminal strip, are shown in Fig. 11-17. One set of lugs is for the r-f section and the other set of lugs is for the oscillator section.

The lugs of each inside row in the two sets of lugs are connected together. You can see this connection if you look at the schematic diagram shown in Fig. 11-14.

Actually, some electrical-pushbutton systems use coils in place of the capacitors used in this system and a capacitor in place of the coil. In such systems, the coils are switched in and out of the system by means of pushbuttons.

Adjustment. The capacitors or coils used in a pushbutton system have fixed values. If capacitors are used, they are of the type that can be adjusted by turning a screw, as shown in Fig. 11-18. Turning the screw in one direction pushes the plates of the capacitor together and turning it in the other direction spreads the plates apart. Each of

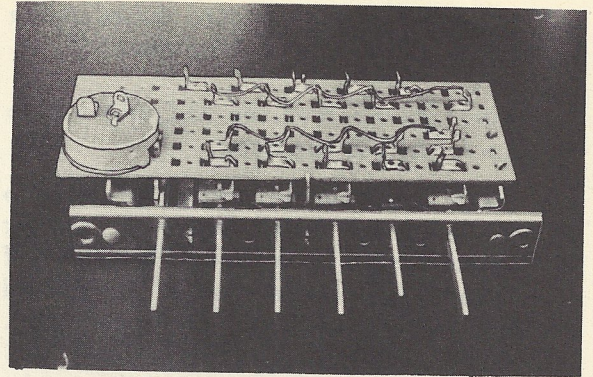


Fig. 11-17

the capacitors can be adjusted over a range of about 20 – 30 kc. If adjustable coils are used instead of adjustable capacitors, turning the screw one way forces the powdered-iron core into the coil and turning it the other way separates the coil from the core. Coils, too, are tunable over a range of about 20 – 30 kc.

The five capacitors or coils used are different from one another so that it is possible to tune them so that they select five stations from any part of the broadcast band. A serviceman can learn the range of each of the capacitors or coils used in the system he is working on by consulting the service notes that apply to the receiver in which the pushbutton system is found.

Actually, all that a serviceman sees is the screw heads of the capacitors or coils that he is working on. These screw heads protrude from holes in the chassis, usually in the rear of the receiver.

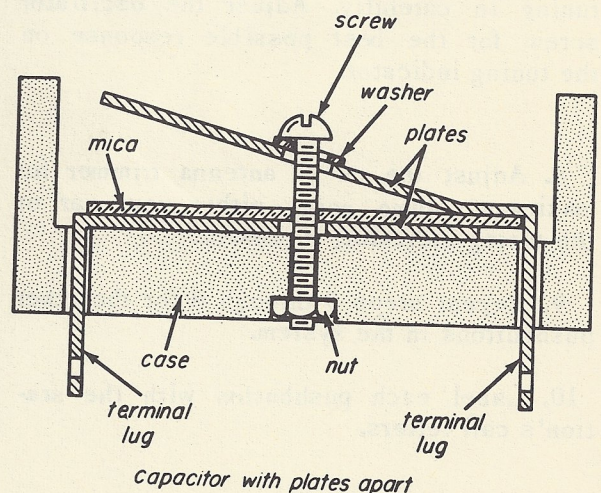


Fig. 11-18

The step by step procedure for adjusting the capacitors or coils is as follows:

1. Turn on the receiver and allow it to warm up for fifteen minutes.
2. Make a list of the desired stations to be tuned in by the pushbuttons. The number of stations should not exceed the number of pushbuttons that are available and should be distributed across the broadcast band.
3. Connect the antenna that is to be normally used.
4. Consult the service notes for the receiver to determine which set of screws is used to tune the oscillator and r-f or antenna stages. Also determine whether the ranges of the capacitor (or coil) adjustments will cover the selected pushbutton stations.
5. Next, tune in a desired station on the manual-tuning control.
6. Push in the pushbutton that will tune in the frequency of the desired station just tuned-in on manual tuning.
7. Carefully adjust the oscillator screw until the same station heard a moment ago on manual tuning is heard again. The adjustment must be made carefully and precisely. If the receiver you are adjusting has an electron-ray indicator or some other tuning indicator, the tuning indicator is usually a better indication than the ear that you are tuning in carefully. Adjust the oscillator screw for the best possible response on the tuning indicator.
8. Adjust the r-f or antenna trimmer for maximum volume using either your ear or the tuning indicator, if present.
9. Repeat steps 5 through 8 for the other pushbuttons in the system.
10. Label each pushbutton with the station's call letters.

11-8. ELECTRICAL PUSHBUTTON TUNING, TROUBLES AND REPAIRS

Common troubles found in the electrical pushbutton-tuning mechanism are either electrical or mechanical.

A common electrical defect is oxidized or dirty switch contacts. This can be recognized by loud cracking sounds heard in the loudspeaker as the pushbutton is pushed. In fact, if the switch is extremely dirty, vibrations such as those caused by people walking in the room may cause noise to be heard in the loudspeaker. To remedy this condition, the contacts should be cleaned and lubricated. There are several proprietary products that are suitable for this purpose. Walso Contactene and General Cement Red Electronic Contact Cleaner are two such commercial products. These products contain a solvent that dissolves the dirt and oxidation. As the solvent evaporates, it deposits a lubricating substance that prevents or reduces oxidation. The solvent is applied with a brush that is attached to the cover of the bottle. The compound should be applied liberally. The brush should be pushed as far into the contacts as possible while the pushbuttons are pushed and released so that the fluid can get at the entire surface of the contacts. The dislodged dirt should be wiped off the brush before it is returned to the bottle.

Another electrical defect is the detuning of the pushbutton circuits due to normal aging of the components. Over a period of time, the value of the inductance of the coil or the capacitance of the electrical capacitor may change. Since tuning depends upon the values of the coil and capacitor, pushbutton detuning may result.

To correct the mistuned condition, all that need be done is to retune all of the pushbuttons. Even though only two of the five may be badly detuned, each of the pushbuttons should be tuned, following the step-by-step procedure given earlier in this booklet.